Math-in-CTE
Sample Health Lesson Plan

Lesson Title: **Alice's Areas**	Lesson # **H-4**

Estimated Time:	

Occupational Area:	**Health**
CTE Concept(s):	**Rule of 9's**
Math Concepts:	**Areas and Percent**

Lesson Objective:	The student will demonstrate a working knowledge of determining areas of figures as they apply to the surface area of the body and its application in health careers, while recognizing it in other contexts.
Supplies Needed:	Pencils, calculators, worksheets, **power point** equipment or copies of power point slides, tape measure, optional: manikin with moulage for burns

THE "7 ELEMENTS"	TEACHER NOTES (and answer key)
1. Introduce the CTE lesson The teacher will explain the following: (Slide 1) The ability to calculate the area of an office, lab, piece of filter paper, or culture medium may be important in a hospital or clinical setting. In addition, in burn care we use a system called the "rule of nines" which is a formula for estimating percentage of body surface areas that are burned. We will look at how this formula may have been developed and use this rule to estimate % body surface area (BSA) that is burned.	**Lesson Length 1.5-2.0 hours** **Health Concept(s):** First Aid (Burns) Integumentary System **Math Concept(s):** Surface Areas Percentages Estimation

2. Assess students' math awareness as it relates to the CTE lesson.	Definitions:
The teacher will ask the students the following questions: How do you find the area of a triangle? How do you find the area of a rectangle? How do you find the surface area of a sphere? How do you find the surface area of a cylinder? How do you calculate percentages? What is the difference between surface area and area? Give examples of each.	**(Slide 2)** **Area**: the number of unit squares in a region. (two dimensional figures) **Surface Area:** the sum of all areas of a figure. (three dimensional figures) **Sphere**: the sum of all points equal distant from a single point called the center. **(Slide 3)** **Cylinder:** a solid figure (three dimensional geometric shape or space figure) with two congruent (equal) parallel bases usually in the shape of a circle and the cylindrical surfaces connecting the two bases. **(Slide 4)** **Rectangle:** a quadrilateral with four right angles with two sets of congruent parallel sides. **(Slide 5)** **Percentage:** the ratio of the part considered compared to the total, multiplied by 100%. **(Slide 6)** **Pi (π):** the ratio of the circumference of a circle to its diameter. The value of pi is about 3.14 **(Slide 7)** **Triangle:** a three sided figure that has a base and a height. **Base:** the side that the triangle sits on. (b)

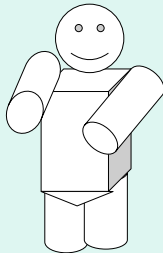|	**Height:** the length from the base to the opposite angle. (h)
	(Slide 8)
	Radius: the distance from the center to the outside edge of the circle.
	Answers to awareness questions:
	(Slide 9)
	The area of a triangle is found by using the formula $A=bh/2$ (base times height divided by 2)
	(Slide 10)
	The area of a rectangle is found by using the formula $A=lw$ (length times width)
	(Slide 11)
	The surface area of a sphere is found by using the formula: $A= 4\pi r^2$ (4 times pi [3.14] times the radius squared)
	(Slide 12)
	The surface area of a cylinder is found by using the formula: $A= 2\pi rh + 2\pi r^2$ (2 times pi [3.14] times the radius times the height plus 2 times pi [3.14] times the radius squared.
	You calculate percentages by dividing the part considered by the whole amount and multiplying by 100%.
	Area is for a two dimensional figure (floors, roofs, roads) Surface area is for three dimensional figures.(vhs case, basketball, textbook, cans, cars, softball bats,)

3. Work through the math example *embedded* in the CTE lesson.

(Slide 13)

Problem Solving Strategy

Alice's Areas

Your patient, Alice, came into the Emergency Department with partial and full thickness burns to her entire right (R) leg after falling into a camp fire. You are to calculate the area of the burn and determine the percentage of her body that is burned.

- We will break her body into different geometric shapes. For example, her head will be a sphere, her arms and legs will be cylinders, her thorax will be a rectangular solid and her perineal area will be a triangle.

Alice's areas

- We will figure the surface area of each part of Alice's body separately and then find the total by adding all the parts together.

- r= 12.62cm

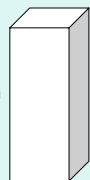### Alice's Arms

- r=4cm

- h=75.62cm

Alice's Thorax

- 40.9cm

- 50.9cm

- 20.9cm

Head

$SA=4\pi r^2$

$=4(3.14)(12.62cm)^2$

$=2000cm^2$

Arms

$SA=2\pi r^2 + 2\pi rh$

$=2(3.14)(4cm)^2 +2(3.14)(4cm)(75.62cm)$

$=2000cm^2$

Thorax-6 sides total

 front and back

$SA=2LW$

$=2(50.9cm)(40.9cm)$

$=4163.6cm^2$

Top and Bottom

$SA=2LW$

$=2(40.9cm)(20.9cm)$

$=1709.6cm^2$
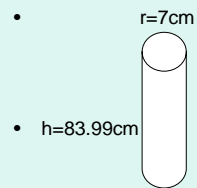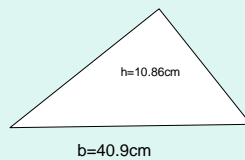
	Two sides
Alice's Legs r=7cm h=83.99cm	$SA=2LW$ $=2(50.9cm)(20.9cm)$ $=2127.62cm^2$ total $8000cm^2$ **Legs** $SA=2\pi r^2 + 2\pi rh$ $=2(3.14)(7cm)^2 + 2(3.14)(7cm)(83.99cm)$ $=4000cm^2$
Alice's perineum h=10.86cm b=40.9cm	**Perineum** $A=bh/2$ $=40.9cm(10.86cm)/2$ $=222cm^2$ TOTAL $2000cm^2 +4000cm^2 +8000cm^2 +8000cm^2 +222cm^2$ $=22222cm^2$

Add all the parts

- Head
- 2 arms
- 2 legs
- Thorax (all six sides)
- Perineum

- Total $22222cm^2$

Find the percentages of each part

- Head   2000/22222(100%)
- =9%
- Arms   2000/22222(100%)
- =9% each
- Thorax 8000/22222(100%)
- =36%
- Legs   4000/22222(100%)
- = 18% each
- Perineal 222/22222(100%)
- =1%

- Rule of nines

What percent of Alice's body was burned?

- 18%
- Implications:
- The percent of body surface area that is burned will be used to determine treatment and prognosis (expected outcome).

Burn Center Referral Criteria:

2nd and 3rd degree burns > 10% BSA in pts<10 or >50 years old

2nd and 3rd degree burns >20% BSA in other age groups

2nd and 3rd degree burns with threat of functional or cosmetic impairment that involve face, feet, hands, genitalia, and major joint

3rd degree burns > 5% BSA in any age group

Pre-Hospital Fluid Replacement: >15 yr old=500 cc/hr
5-15 yr old=250 cc/hr   <5 yr old=150cc/hr

Note An individual palm equals approx. 1% of BSA and can be used to estimate scattered, irregular burns.

Teacher note: show transparency of rule of nines. You may want to explain that infants/toddlers have different numbers.

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4. Work through *related, contextual* math-in-CTE examples.

The teacher will give the students the following related questions.

Sample problems

- 1. The surface area of medical office exam room floor needs to be determined in order to buy carpeting. The room measures 4 yards by 3 yards. How much carpeting should be ordered?

Solution

- $A = lw$

  $= (3yd)(4yd)$

  $= 12yd^2$

Lower Level Math

Intermediate level Note: the formula for area of a circle is πr^2

Sample Problem 2

- A circular culture plate with a radius of 5cm is placed in an open area outside a clinic for six hours. At the end of this time the plate is taken to lab for examination. It is observed that there are 54 grains of pollen per square centimeter of surface area. Determine the surface area of the plate and the number of pollen grains present.

- It's your turn. Please measure the circumference of your partners head using a tape measure. Find the area of the head and try to find the total surface area.

Solution 2

- $A=\pi r^2$
- $=3.14(5cm)^2$
- $=78.5cm^2$

  Pollen grains 54(78.5)=4239 grains

Higher level

Answers will vary

See formula below

Solution

- $r=c/2\pi$

- $SA=4\pi r^2$

- Total surface area=SA/.09

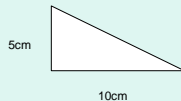**5. Work through *traditional math* examples.**

Sample 3

- What is the surface area of a basketball that has a radius of 15cm?

http://www.nba.com/

Sample 4

- What is the area of a triangle that has a base of 10cm and a height of 5cm?

5cm

10cm

Solution 3

- $A = 4\pi r^2$
- $= 4(3.14)(15cm)^2$
- $= 2826cm^2$

Solution 4

- $A = bh/2$
- $= 10cm(5cm)/2$
- $= 25cm^2$

6. Students demonstrate their understanding.

The teacher will now have the students demonstrate their understanding by doing the following:

Basic Level:

You are an administrative assistant in a medical office. You are asked to estimate the amount of carpet that will be needed for two exam rooms. One room in 9x13 and the other is 8x9. Approximately how many yards of carpeting will need to be ordered?

Intermediate Level:

Answer: SA = LW 9x13=117 and 9x8=72

72 + 117=189 yd²

Prepare a manikin with burns to (R) chest, (R) arm, and (R) leg. Give the scenario that a 30 yr old firefighter fell through the floor of a structure. You are to estimate the % BSA that is burned.	Answer:
	9 % (2nd degree)
Example:	9% (2nd degree)
The firefighter's entire (R) arm is burned. (2nd degree)	
There is a 2nd degree burn from the midsternal area of chest to the midaxillary line. (2nd degree)	
The lateral ½ of (R) thigh. (3rd degree)	4.5% (3rd degree)
Two palm-sized burns to the (R) lower leg. (3rd degree)	2% (3rd degree)
	Total=24.5% BSA that is burned.
	You can alter these numbers as desired. If you do not wish to use the manikin, you could use an overhead with the areas and description (ie 1st, 2nd, 3rd degree) colored in or just verbally give the students these areas. You can take this a step further by asking:
	**What should be the disposition of this patient? Answer: Referred to a burn center
	What would be the initial fluid guidelines for this patient? Answer: 500 cc/hr
Higher Level:	
You are a vet tech at a zoo. Rex the elephant has sustained a burn to his (L) leg caused by stepping through a flaming hoop. You are to apply a sterile bandage to the entire leg and you need to determine how long of a wrap should be used to completely cover the leg one time. Your wrap is 10 cm wide. The footprint shows a leg diameter of 16 cm and the length of Rex's leg is 150 cm. Assuming the leg is a cylinder; calculate the length of wrap needed.	***Note: When wrapping the elephant's leg, we are not wrapping the foot or the transverse plane of the top of the leg…..therefore the formula for surface area would be reduced to $2\pi rh$

SA=2πrh

=2(3.14)(8cm)(150cm)

=7536cm²

The SA of the wrap =SA of leg

LW=7536cm^2

L(10cm)=7536cm^2 dividing by ten gives

L= 753.6cm

Or 7.536m which is 8.68yards so you would need a wrap 9yards long. This is an African Elephant so he would not know yards! You could also test their math abilities by saying that you would overlap each turn by 3 cm.

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7. Formal assessment.

Problem #1

US

Sample 5

- What will be the surface area of a pop can that has a height of 12cm and a radius of 4cm?

- 4cm

12cm

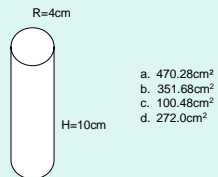- http://www.incrediblegifts.com/cocancojar.html

Problem #2

Sample 6

- Find the percentage of students who became ill this past month if 375 were ill out of a total student population of 2756.

Problem #3

Standardized Test Questions

- 1. Find the surface area of the cylinder.

R=4cm

H=10cm

a. 470.28cm²
b. 351.68cm²
c. 100.48cm²
d. 272.0cm²

Solution 5

- $A = 2\pi rh + 2\pi r^2$
- $= 2(3.14)(4cm)(12cm) + 2(3.14)(4cm)^2$
- $= 301.44cm^2 + 100.48cm^2$
- $= 401.92cm^2$

Solution 6

- %= part/total (100%)
- =375/2756(100%)
- =13.6%

Answer:

B

$SA = 2\pi rh + 2\pi r^2$

$SA = 2(3.14)(4)(10) + 2(3.14)(16)$

$SA = 351.68cm2$

Problem #4	Answer:
Standard test questions • What is the area of the right triangle below, in square centimeters? • • a. *x* b. *y* c. 5*x* d. 5*y* e. 5*xy* (right triangle with sides labeled *x*, *y*, and 10)	C SA=bh/2 SA=10X/2 =5X
Problem #5 A person has burned their perineal area and their entire anterior chest (thorax).What is the total BSA that was burned?	Solution: Perineal Area= 1% Anterior Thorax=18% Total=19%

Health Lesson

Name_____

Worksheet for Alice's Areas

Formulas

Surface Area of a sphere= 4πr² where r is the radius

Surface Area of cylinder= 2πrh + 2πr² where h is the height

Area of a rectangle= lw   where l is the length and w is the width

Area of a triangle= bh/2

Area of a circle= πr²

Your patient, Alice, came to the emergency department with partial and full thickness burns to her entire right leg after falling into a campfire. You are to calculate the area of the burn and determine the percentage of her body that is burned. We break her body into the following different geometric shapes:

Head: sphere

Arms & Legs: cylinders

Anterior and Posterior Thorax: rectangle

Perineum: triangle

Calculate the area of the following body parts:

1. **Head**   radius = 12.62 cm

2. **Arms**   radius = 4 cm, height = 75.62 cm

3. **Thorax** length = 20.9 cm, height = 50.9 cm width=40.9 cm

    (there are 6 sides – you may want to draw a picture)

4.. **Legs** radius = 7 cm, height = 83.99 cm

5. **Perineum** base=40.9cm. height=50.9cm. width=40.9cm

6. **Total surface area** (total #1 - #5):

7. **What percent of Alice's body was burned?**

    (surface area of 1 leg ÷ total surface area x 100)

8. The area of a medical office exam room floor needs to be determined in order to buy carpeting. The room measures 4 yards by 3 yards. How many square yards of carpeting should be ordered?

9. A circular culture plate with a radius of 5 cm is placed in an open area outside a

clinic for six hours. At the end of this time the plate is taken to lab for examination.

It is observed that there are 54 grains of pollen per square centimeter of area.

Determine the area of the plate and the number of pollen grains present.

10. It's your turn. Please measure the circumference of your partners head using a tape measure. Find the area of the surface area of the head and try to find the total surface area of your partner's body.

Use the formula $r = c/2\pi$ where c is the circumference measured,   then use $SA = 4\pi r^2/.09$ to find the total surface area of the body.

11. What is the surface area of a basketball that has a radius of 15 cm?

12. What is the area of a triangle that has a base of 10 cm and a height of 5 cm?

13. You are an administrative assistant in a medical office. You are asked to estimate the amount of carpet that will be needed for two exam rooms. One room is 9 x 13 yd and the other is 8 x 9 yd. Approximately how many square yards of carpeting will need to be ordered?

14. A 30 year old firefighter fell through the floor of a building. You are to estimate the % body surface area that is burned. The firefighter's entire (R) arm is burned. (2nd degree). There is a 2nd degree burn from the midsternal area of chest to the midaxillary line. The lateral ½ of (R) thigh. (3rd degree). Two palm-sized burns of the (R) lower leg. (3rd degree).

15. You are a vet tech at a zoo. Rex the elephant has sustained a burn to his (L) leg caused by stepping through a flaming hoop. You are to apply a sterile bandage to the entire leg and you need to determine how long of a wrap should be used to completely cover the leg one time. Your wrap is 10 cm wide. The footprint shows a leg diameter of 16 cm and the length of Rex's leg is 150 cm. Assuming the leg is a cylinder; calculate the length of the wrap needed.

Quiz Alice's Areas

1. What will be the surface area of a soda pop can that has a height of 12cm and radius of 4cm?

2. Find the percentage of students who became ill this past month if 375 were ill out of a total population of 2756.

3. Find the surface area of this cylinder and choose the best answer.
   h=10cm

r=4cm
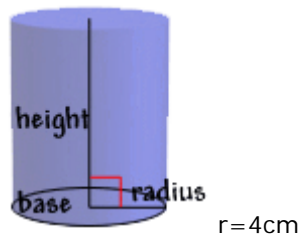
   a. 470.28cm^2
   b. 351.68cm^2
   c. 100.48cm^2
   d. 272.0cm^2

4. What will be the area of the right triangle below in square centimeters?

   x

   y

   10cm
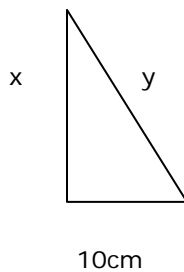
    a. x

    b. y

    c. 5x

    d. 5xy

5. A person has burned their perineal area and their entire anterior chest (thorax). What is the total BSA that was burned?

References:

Nichols, E.D. & Schwartz, S.L.; *Mathematics Dictionary and Handbook.* Honesdale, PA: Nichols Schwartz Publishing, 1999.

Hayden, J.D., & Davis, H.D., *Fundamental Mathematics for Health Careers.* Albany, N.Y.: Delmar Publishing, 1990.

Northern California EMS, Inc. *Policy and Procedure Manual: Burn Protocol.* January 1, 2002.

"Rule of Nines"